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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/298,064	04/22/1999	GUANGCAI XING	2616-US/RTP/	1649

32588 7590 11/06/2002

APPLIED MATERIALS, INC.
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EXAMINER	
ZERVIGON, RUDY	
ART UNIT	PAPER NUMBER
1763	26

DATE MAILED: 11/06/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Application No.	Applicant(s)	
09/298,064	XING ET AL.	
Examiner	**Art Unit**	
Rudy Zervigon	1763	

Office Action Summary

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1 136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 August 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 17-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7 and 17-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1-4, 6, 7 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by P. J. Matsuo et al[1]. P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I, Introduction; Figure 1). Additionally, the variable length of the plasma delivery tube is assessed under numerous conditions such as etch rates (Section III.A.2, p.1803), reaction layer thickness (Section III.C.4, p.1809), atomic (neutral) and reactive (radical) species concentration (Section IV.B, p.1812).

Specifically, and to further illustrate the teachings of P. J. Matsuo et al, the researchers describe:

i. a first reaction chamber ("downstream tubing/lining", Figure 1)

ii. a gas source (fluoromethane, oxygen, nitrogen, Figure 1) coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber

[1] *J.Vac.Sci.Technol.* A **15**(4), Jul/Aug 1997

iii. an excitation energy source ("applicator, 2.45GHz", Figure 1) coupled to the first reaction chamber to generate a nitrogen plasma comprising ions and radicals from the nitrogen gas

iv. a second reaction chamber ("processing chamber", Fig.1) adapted to house a substrate at a site in the second reaction chamber

v. wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the ions (Figure 4) at a plasma generation rate such that the radicals react with the substrate in a process conversion step (film deposition, Refer to Figure 10(d) and section C.1 - "At point (d) N_2 is injected once more and the reaction layer thickness increases again.")

vi. the excitation energy source supplies energy having a microwave frequency to generate a plasma from the nitrogen gas (abstract, first sentence)

vii. The dimensions of the first reaction chamber ("...as the distance from the plasma to the etching region is increased...") are configured such that substantially all of the ions generated by the nitrogen plasma are changed from an ionic state to a charge neutral state within the first reaction chamber (Section IV.B, p.1812)

viii. An apparatus (Figure 1) for exposing a substrate to plasma, comprising a first reaction chamber ("downstream tubing/lining", Figure 1)

ix. means for supplying a nitrogen gas (fluoromethane, oxygen, nitrogen, Figure 1) to the first reaction chamber

x. means for generating a plasma from the nitrogen gas ("applicator, 2.45GHz", Figure 1)

xi. the plasma comprising ions and radicals (definition of plasma)

xii. a second reaction chamber ("processing chamber", Fig.1) having means for housing a substrate

xiii. means for providing the plasma to the second reaction chamber substantially free of ions such that the radicals react with a substrate in a process conversion step (Section IV.B, p.1812)

Item 6.v. is implicitly taught according to Figure 4. As shown in Figure 4, there are non-zero etch rates up to 125cm of first reaction chamber lengths. As such, lifetime of the ions, up to and including these distances, are sufficiently long enough so "that the radicals react with the substrate in a process conversion step".

3. Claims 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Mehrdad M. Moslehi (USPat. 5,082,517). Mehrdad M. Moslehi identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (column 1, lines 5-15). The control of the composition of neutral and reactive species, and it's importance to plasma processing, is taught by Mehrdad M. Moslehi (column 1, lines 46-68; column 2, lines 37-42; column 4, lines 9-14; column 12, lines 56-68). Specifically, Mehrdad M. Moslehi describes a process conversion (column 4, lines 55-60) system where:

i. A system (Figure 1) for reacting a plasma with a substrate

ii. a first chamber (20, Figure 1)

iii. a gas source (12, Figure 1) coupled to the first chamber comprising

iv. constituents (12, Figure 1) adapted to react with a substrate (48, Figure 1)

v. an energy source coupled to the first chamber (38)

vi. a second chamber (24) configured to house a substrate for processing

vii. a system controller (40) configured to control the introduction of a gas from the gas source into the first chamber (column 12, lines 65 – column 13, line 14; column 13, lines 57-68, 33-43) and to control the introduction of an energy from the energy source (column 5, lines 43-52)

viii. a memory coupled to the controller comprising a computer readable medium having a computer-readable program embodied therein for directing operation of the system (column 5, lines 43-52; column 14, lines 3-20), the computer readable program comprising:

ix. instructions for controlling the gas source (column 14, 3-20) and the energy source (column 14, lines 3-20) to convert a portion of a gas supplied by the gas source into a plasma comprising plasma ions and radicals (column 4, lines 9-14; column 10, lines 55-60, definition of plasma) and to deliver the plasma to the second chamber substantially (column 4, lines 9-14; column 11, lines 54-63; column 1, lines 46-52) free of ions to react with a substrate in the second chamber in a process conversion step

Claim Rejections - 35 USC § 103

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over P. J. Matsuo et al[2] as applied to claims 1-4, 6, and 7 above, and further in view of Yamazaki et al (USPat. 6,130,118). P. J. Matsuo et al identically describe a plasma semiconductor processing apparatus that generates a microwave plasma remotely relative to the substrate's location (Section I, Introduction; Figure 1). However, P. J. Matsuo et al does not describe a rapid thermal processing chamber as a second chamber.

Yamazaki et al describes a plasma reaction apparatus for film deposition (column2, lines 20-25). Specifically, Yamazaki et al describes a substrate housing rapid thermal processing (RTP) chamber (104, Figure 4; column 6, lines 9-15).

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[2] *J.Vac.Sci.Technol.* A **15**(4), Jul/Aug 1997

It would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber.

Motivation for substituting the P. J. Matsuo et al second reaction chamber for the Yamazaki et al substrate housing rapid thermal processing (RTP) chamber is drawn to the enhanced insulation and thermal conductivity of prepared films (column 6, lines 57-59).

Response to Arguments

6. Applicant's arguments filed August 19, 2002 have been fully considered but they are not persuasive.

7. Applicant's arguments regarding the 102(b) rejections applying Matsuo et al amount to the assumption that Matsuo's etch rates are the sole objective for varying the tube length as shown in Figures 4, 7, 12, 19, and 25. In contrast, Matsuo's variable length of the plasma delivery tube is assessed under numerous conditions besides etch rates (Section III.A.2, p.1803) including reaction layer thickness (Section III.C.4, p.1809) and atomic (neutral)/reactive (radical) species concentration (Section IV.B, p.1812) all of which are parameters associated with Matsuo's processing chamber.

1. Regarding the lifetime of ions in the plasma corresponding to a predetermined length of Applicant's tube 320, it is supported in Applicant's specification (Page 18, First paragraph) that in one embodiment the tube length is 12 inches (30.48cm). Matsuo specifically teaches tube lengths between 0cm and 125cm.

2. Applicant's position that Moslehi does not teach first and second chambers separated by a distance equivalent to "the lifetime of nitrogen ions" is not convincing. Moslehi teaches a "plasma density controller" influencing control over "activated ions and neutral species in plasma" (column 4, lines 9-15).

Conclusion

3. Applicant's amendment necessitated the new ground of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

1. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 872-9311. The official before final fax phone number for the 1763 art unit is (703) 872-9310. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.

JEFFRIE R. LUND
PRIMARY EXAMINER